Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge
Quarterly Update Report – April 2010

Prepared by:
Matt Harwell, A.R.M. Loxahatchee National Wildlife Refuge

With contributions from Donatto Surratt, and Mike Waldon

Overview

This update is a summary of activities since the previous status report of January 2010 on the implementation of the Refuge's Enhanced Water Quality Monitoring and Modeling Program. A project overview, and other detailed information about the program can be found at: http://sofia.usgs.gov/lox_monitor_model/. The primary objective of this overall program (Brandt et al. 2004) focuses on providing information for use in ecological management of the Refuge (e.g., USFWS 2007a, b).

The Refuge's monitoring component of this program also addresses one of the Consent Decree Principals recommendations (17 December 2003):

> ***B. Enhancing Monitoring of the Refuge***
> *Design and implement an enhanced monitoring program to improve spatial and temporal understanding of factors related to phosphorus dynamics.*

The Refuge's modeling component of this program also addresses several of the Consent Decree Principals recommendations (17 December 2003):

> ***C. Modeling of the Refuge***
> *1. Develop a water quality/hydraulic model for the Refuge with a phosphorus cycling component.*
> *2. Evaluate issues associated with phosphorus loads and transports within the L-40 and L-7 canals.*
> *3. Develop and track a simple phosphorus mass-balance model for the Refuge.*

Information Availability

Through collaboration with USGS, information from the Refuge's Enhanced Water Quality Monitoring and Modeling Program has been made available on the USGS' SOFIA web site at: http://sofia.usgs.gov/lox_monitor_model/.

Final data for monthly samples through May 2006 are publicly posted on DBHYDRO by the SFWMD at http://my.sfwmd.gov/dbhydroplsql/show_dbkey_info.main_page. Data for June 2006-March 2010 are posted on the Technical Oversight Committee's web site at https://my.sfwmd.gov/portal/page/portal/pg_grp_sfwmd_era/pg_sfwmd_era_techovercommittee. This report includes information from samples collected through March 2010.

Water Quality Data Analyses Update

Primary efforts for this quarter involved exploring mechanisms to continue translating information from the program to aid in Refuge management decisions, and working on the program's Annual Report.

Monitoring Update (January 2010 – March 2010)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 37 stations in January, 37 stations in February, and 35 stations in March 2010 (**Table 1**).

Total phosphorus data available to date for April 2009 to March 2010 are presented in **Table 1**. Maps of stations where samples were collected for January 2010 through March 2010 are presented in **Figures 2-4**.

Conductivity sonde deployment information for April 2009 to March 2010 is presented in **Table 2**.

Modeling Update

During the first quarter of 2010, the Refuge modeling team continued efforts to finalize model versions. Efforts continued on documentation of model development, use, and appropriate application. Continued develop of hydrologic performance measures was undertaken, including development and review of a high-water stage performance measure to address Refuge water needs including the proposed River of Grass project.

Next Steps

The next steps for this program include additional efforts on the Annual Report, and additional model development and application.

References

Brandt, L.A., Harwell, M., Waldon, M. (2004) Work Plan: Water Quality Monitoring and Modeling for the A.R.M. Loxahatchee National Wildlife Refuge: 2004-2006. Prepared for the A.R.M. Loxahatchee National Wildlife Refuge. April, 2004. 33 pp.

USFWS. (2007a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Monitoring and Modeling Program – 2nd Annual Report – February 2007. LOXA06-008, U.S. Fish and Wildlife Service, Boynton Beach, FL. 183 pp.

USFWS. (2007b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 3rd Annual Report – October 2007. LOXA07-005, U.S. Fish and Wildlife Service, Boynton Beach, FL. 116 pp.

USFWS. (2009) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 4th Annual Report – July 2009. LOXA09-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 106 pp.

Table 1. Total phosphorus data (ppb) available for April 2009 – March 2010 from the Enhanced Water Quality Monitoring Program for: (a) marsh, and (b) canal stations for the A.R.M. Loxahatchee National Wildlife Refuge. Graphical representation of station locations are shown in Figure 1.

a) Marsh stations

Marsh Station	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10
LOXA101	-	-	32	9	20	11	10	8	9	10	7.4	13
LOXA102	-	-	9	U	-	9	6	7	-	5	3.9	4
LOXA103	-	-	10	U	20	10	12	9	8	7	12	-
LOXA105	-	-	28	6	23	19	16	13	11	11	9.7	U
LOXA106	-	-	21	U	19	11	15	8	7	5	U	U
LOXA107	-	-	13	12	-	17	5	-	-	4	U	-
LOXA108	-	-	5	4	-	7	4	-	6	7	7.6	9.9
LOXA109	-	-	12	U	15	8	U	8	4	7	6.3	U
LOXA110	-	-	3	6	14	9	U	5	11	8	4.9	4.2
LOXA111	-	-	4	U	14	7	U	6	U	5	U	U
LOXA112	-	-	12	U	15	19	U	6	5	6	4.5	U
LOXA113	-	-	5	6	14	11	U	4	17	5	U	U
LOXA114	-	-	5	U	13	8	U	4	U	4	U	U
LOXA117	-	-	31	13	24	12	5	11	9	12	4.7	4.2
LOXA118	-	-	7	21	16	6	4	10	4	5	3.8	U
LOXA119	-	-	8	4	15	5	6	8	5	5	U	U
LOXA120	9	-	2	U	14	5	U	6	27	3	U	U
LOXA122	-	-	22	15	26	9	5	9	9	6	4.9	U
LOXA124	-	-	37	13	21	18	10	9	13	7	9.2	19
LOXA126	-	-	15	12	18	12	U	11	8	6	4.9	14
LOXA127	-	-	10	5	21	19	U	8	5	4	U	U
LOXA128	-	-	2	U	33	7	U	4	-	9	U	U
LOXA130	-	-	17	13	17	12	9	17	12	6	7.1	3.4
LOXA131	-	-	5	9	17	4	U	14	7	8	5.7	U
LOXA133	-	-	140	16	-	37	25	56	19	26	28	14
LOXA134	-	-	29	7	20	16	3	24	10	8	7.8	19
LOXA136	-	-	51	30	25	26	15	-	13	13	7.7	17
LOXA137	-	-	27	8	21	14	6	15	9	9	8.6	5.3
LOXA138	-	-	7	13	44	8	U	6	9	9	4.4	U
LOXA139	-	-	14	5	13	9	6	6	-	3	6.7	U
LOXA140	-	-	20	12	18	13	11	10	9	9	4.5	U
LOXA141	-	-	12	5	22	10	8	15	8	14	9.6	U
MAX	9	0	140	30	44	37	25	56	27	26	28	19
MIN	9	0	2	4	13	4	3	4	4	3	4	3

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 1 cont.

b) Canal stations

Canal Station	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10
LOXA104	30	30	60	42	44	47	27	37	30	27	31	27
LOXA115	19	11	26	64	41	43	26	24	28	26	22	20
LOXA129	44	34	130	33	80	42	25	50	28	32	38	54
LOXA132	37	58	130	30	77	57	36	46	31	36	37	38
LOXA135	33	45	130	61	61	43	36	57	40	28	30	32
MAX	44	58	130	64	80	57	36	57	40	36	38	54
MIN	19	11	26	30	41	42	25	24	28	26	22	20

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 2. April 2009 – March 2010 conductivity sonde deployment information, separated by transect, for the A.R.M. Loxahatchee National Wildlife Refuge. X = data collected from sonde deployment during that month. Graphical representation of station locations are shown in Figure 1.

	2009									2010		
Site ID	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
LOXA104	X	X	X	X	X	X	X	X	X	X	X	X
LOXA105		X		X		X		X		X		X
LOXA106		X		X		X		X		X		X
LOXA107		X		X		X		X		X		X
LOXA108		X		X		X		X		X		X
LOXA111	X		X		X		X		X		X	
LOXA112	X		X		X		X		X		X	
LOXA113	X		X		X		X		X		X	
LOXA114	X		X		X		X		X		X	
LOXA115	X	X	X	X	X	X	X	X	X	X	X	X
LOXA116		X		X		X	X		X			X
LOXA117		X		X		X	X		X			X
LOXA118		X		X		X	X		X			
LOXA119		X		X		X	X		X			X
LOXA120		X		X		X	X		X			X
LOXA126	X		X		X		X		X		X	
LOXA127	X		X		X		X		X		X	
LOXA128	X		X		X		X		X		X	
LOXA129	X	X	X	X	X	X	X	X	X	X	X	X
LOXA130		X		X		X		X		X		X
LOXA131		X		X		X		X		X		X
LOXA132	X	X	X	X	X	X	X	X	X	X	X	X
LOXA133		X		X		X		X		X		X
LOXA135	X	X	X	X	X	X	X	X	X	X	X	X
LOXA136		X		X		X		X		X		X
LOXA137		X		X		X		X		X		X
LOXA138		X		X		X		X		X		X
LOXA139		X		X		X		X		X		X
LOXA142		X		X	X		X		X		X	X
LOXA143	X		X		X		X	X	X		X	
LOXA144	X		X		X		X	X	X		X	
LOXA145	X		X		X		X	X	X		X	
LOXA146	X		X		X		X	X	X		X	
LOXA147	X		X	X		X		X		X		X
LOXA148	X		X		X		X	X	X		X	
LOXA149	X		X		X		X	X	X		X	
LOXA150	X		X		X		X	X	X		X	
LOXA151	X	X	X	X	X	X	X	X	X	X	X	X
LOXA152	X	X	X	X	X	X	X	X	X	X	X	X
LOXA153	X	X	X	X	X	X	X	X	X			
I-8C	X	X	X	X		X	X		X	X		
LOX04		X		X		X		X		X		X
LOX06	X		X		X		X		X		X	
LOX07	X		X		X		X		X		X	
LOX08	X		X		X		X		X		X	
LOX09	X		X		X		X		X		X	
LOX10	X		X		X		X		X		X	
LOX15	X		X		X		X		X		X	

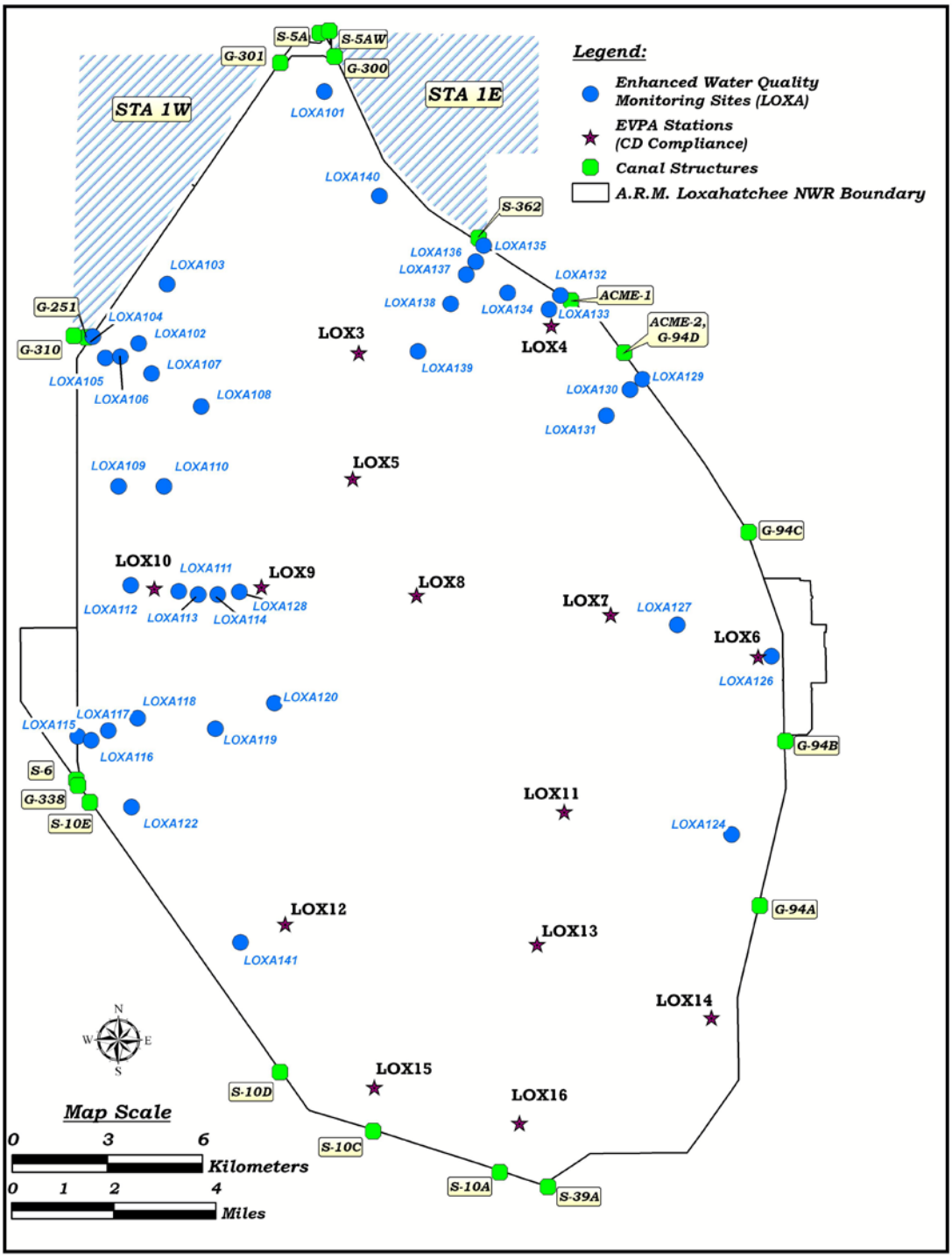

Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

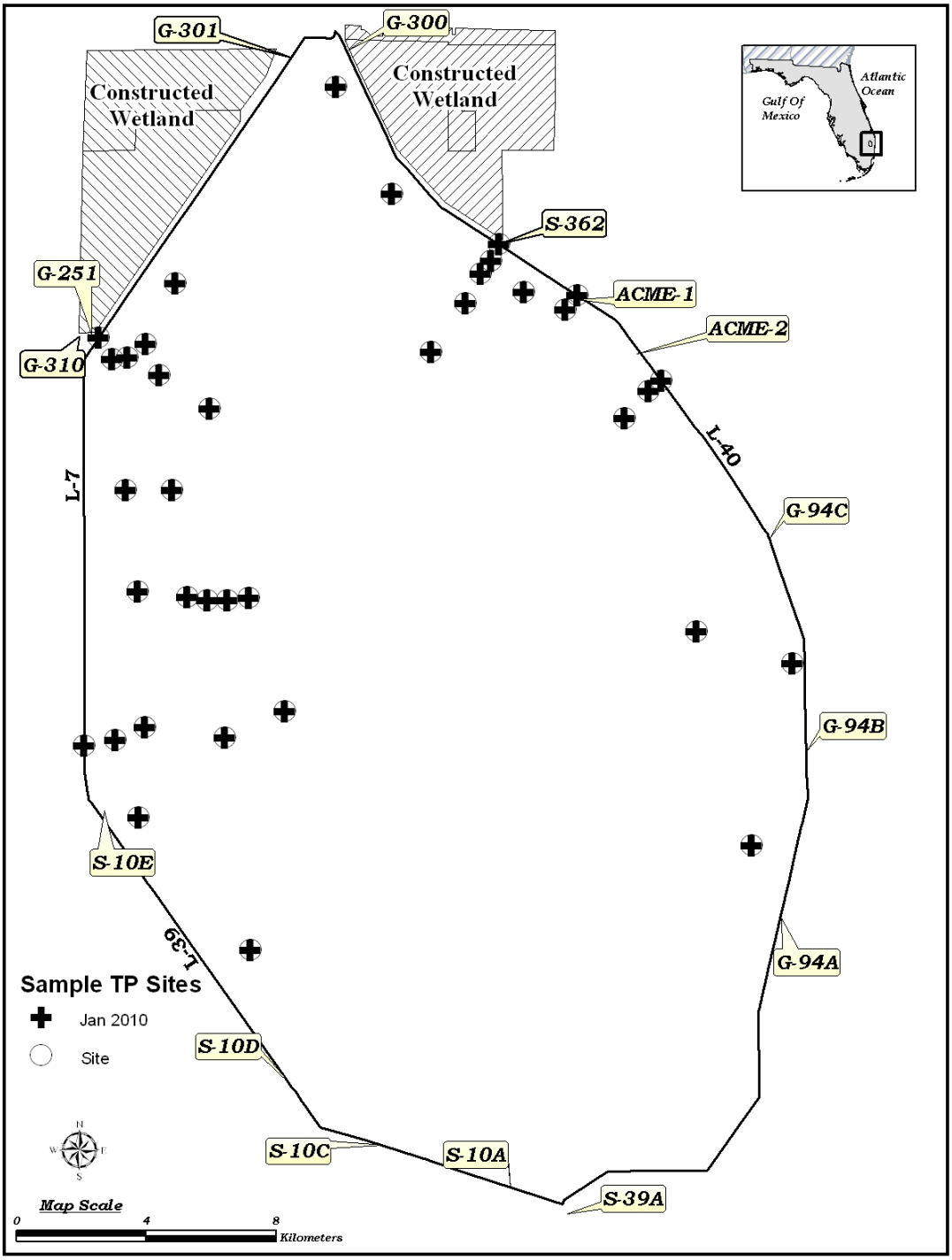

Figure 2. January 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

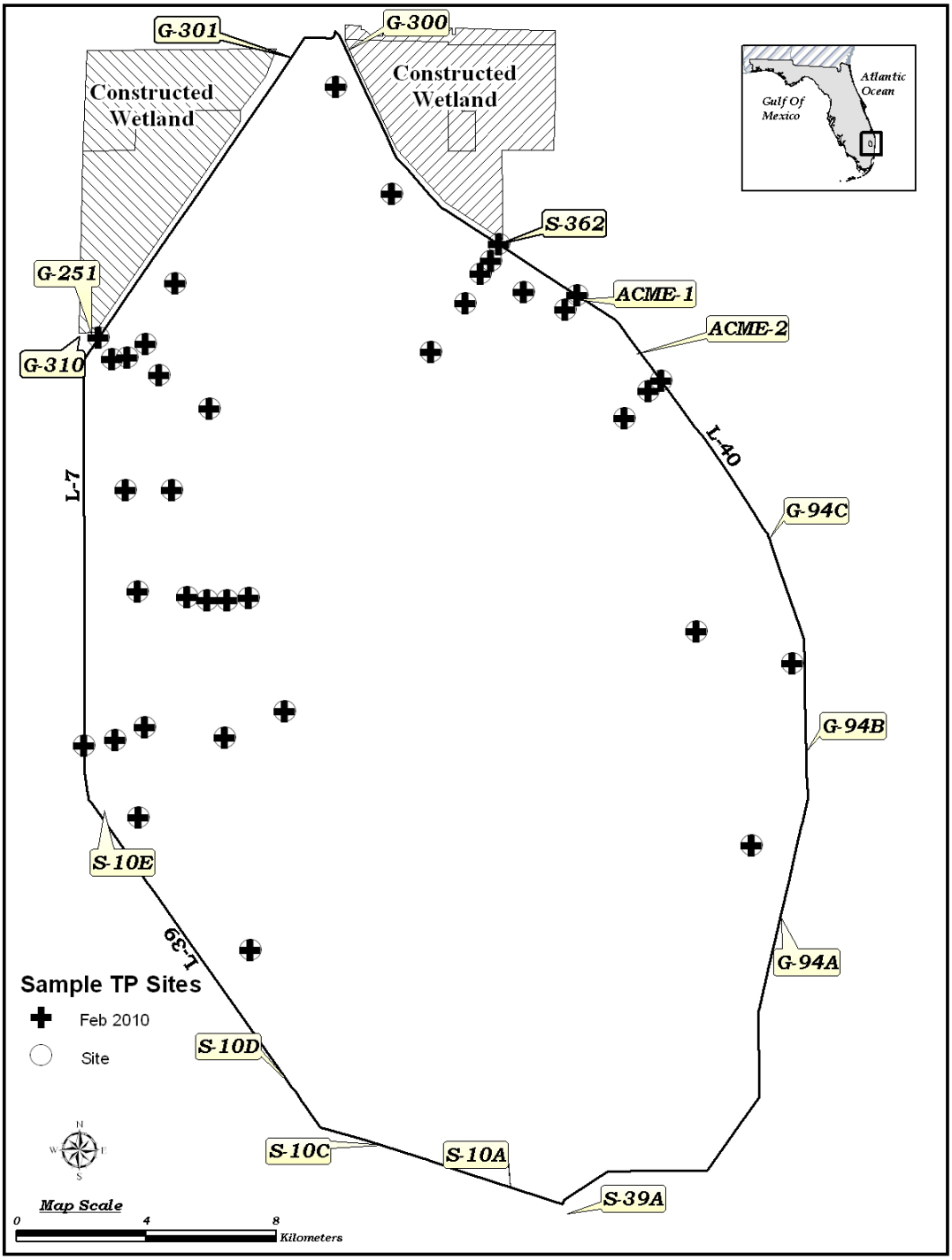

Figure 3. February 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

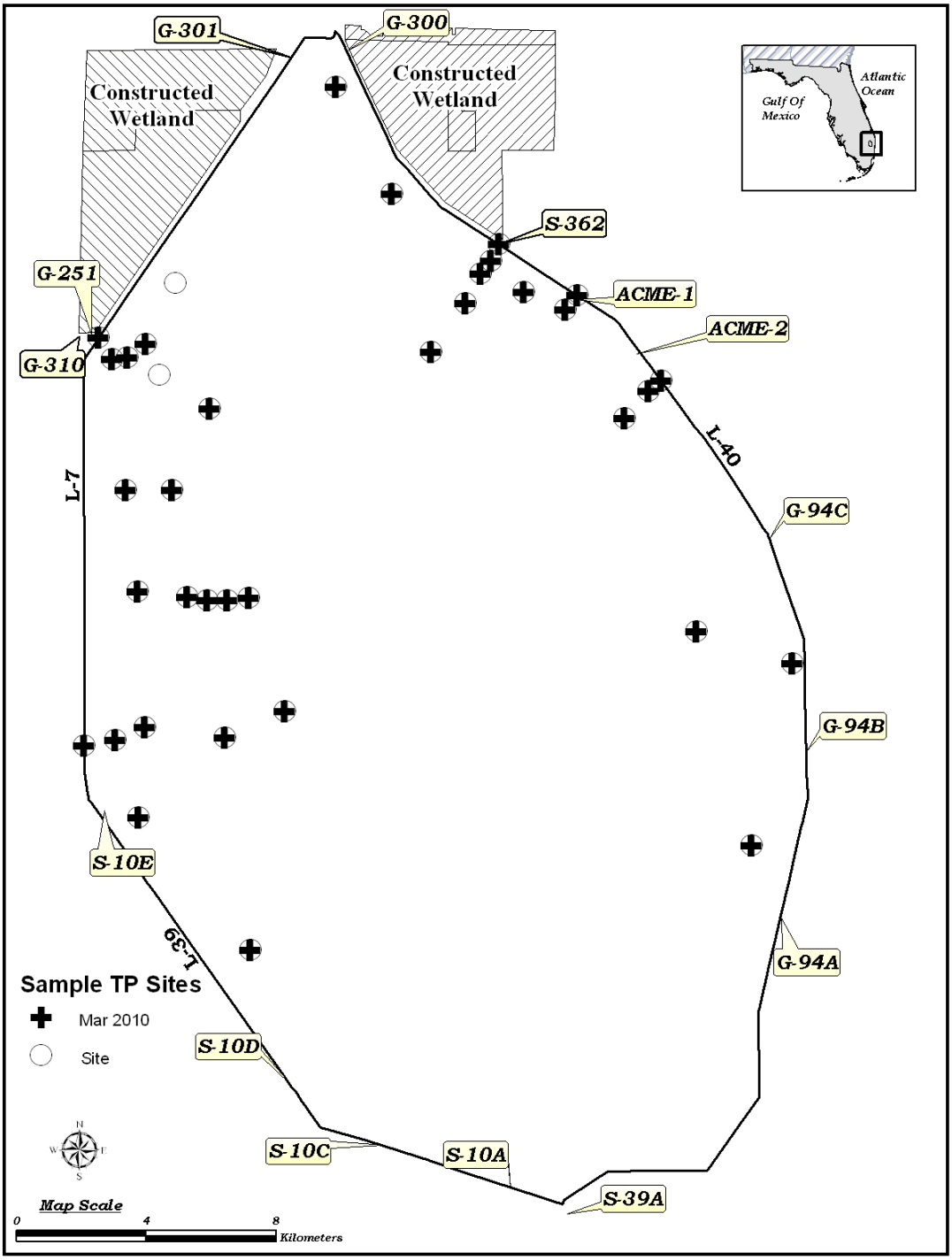

Figure 4. March 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.